GEORGETOWN COLLEGE OBSERVATORY (WASHINGTON, D. C.)

A recent note from the Director of the Georgetown College Observatory recites that the old 5-inch equatorial (used by Fathers CURLEY, SECCHI and SESTINI) is now being dismounted to give place to the new 12-inch equatorial. The Director, Rev. JOHN G. HAGEN, S. J., proposes to devote the new equatorial to the observation of the fainter variable stars.

Father HAGEN also says that an English translation of F. BRAUN'S recent work on Cosmogony (*Ueber Kosmogonie vom Standpunkte Christlicher Wissenchaft*, etc., 1889), is now preparing, and that it will be issued (so I understand) by the care of the staff of the Georgetown College Observatory. E. S. H.

OBSERVATORY OF THE CATHOLIC UNIVERSITY OF AMERICA, BROOKLAND (WASHINGTON, D. C.)

A recent note from Rev. GEORGE M. SEARLE, Director of the observatory, gives its geographical position as—

Latitude 38° 56′ 15″ north.
Longitude $5^h\ 8^m\ 0^s.0$ west.

The position of the U. S. Naval Observatory is—

Latitude 38° 53′ 38″.8.
Longitude $5^h\ 8^m\ 12^s.09$.

Professor SEARLE has a five-inch refractor in use, but expects soon to mount a 9-inch refractor, just completed by Mr. CLACEY, of Boston. E. S. H.

COMPARISON OF SOME PHOTOGRAPHS AND DRAWINGS OF THE NEBULA OF ORION.

Mr. ISAAC ROBERTS, F. R. A. S., has kindly sent me a number of paper-prints of his remarkable negatives of nebulæ, and among them is a truly wonderful picture of the nebula of *Orion*, from a negative made February 4, 1889, with an exposure of 205 minutes. The instrument used was a reflector of 20 inches aperture and 100 inches focus. The print is an excellent one, but it probably fails to do full justice to the original negative, which, most likely, shows stars something like a full magnitude fainter than the print itself. I have also compared a beautiful print (enlarged seven times), which I owe to the kindness of Mr. COMMON. It was made in 1883, with his 3-foot reflector and an exposure of 37^m. The same remarks as to the loss

in printing apply here also. We have lately made, at the Lick Observatory, a few negatives of the *Orion* nebula, under good circumstances. The exposures have been made by Mr. SCHAEBERLE and myself, and the plates have been developed by Mr. BURNHAM and Mr. BARNARD. I have made a comparison between these negatives, the prints by Mr. COMMON and Mr. ROBERTS, the General Catalogue of Stars in the Nebula by Professor G. P. BOND, and an unpublished drawing of the Nebula, by Dr. J. F. J. SCHMIDT.

A brief summary of the results of the comparison may be of interest, as illustrating the performances of different telescopes, and as exhibiting the excellencies of the photographic methods. It is known that Professor BOND's catalogue of stars in the nebula required several years' work. It includes nearly every star visible in the Harvard College telescope down to the 15 or 16 magnitude on Professor BOND's scale (which calls a star 17–18 mag., which is 15 magnitude on ARGELANDER'S scale).

The following table contains notes of the comparison:

List of some of the stars of BOND'S *General Catalogue of Stars in the Nebula of Orion, which have been identified in the photograph of Mr.* ROBERTS.

[Usually no account is taken of stars brighter than 13.0 in BOND'S catalogue. BOND'S magnitude, 17–18, corresponds to ARGELANDER'S 15 magnitude].

STAR.	BOND'S MAG.	
122	10.8	Compare in the photograph 122 (10.8) with 176 (10.8). 122 is very much fainter.
175	13.9	175 (13.9) is about equal to 122 in the photograph.
178	11.5	178 (11.5) is about 14 mag. in the photograph. Compare it with 326 (11.5), 705 (11.5) and with 175 (13.9).
211	13.1	
212	13.1	
[216	13.9]	is not shown in the photograph. It is immersed in nebulosity.
222	13.9	
241	14.8	
260	14.2	These two stars are just visible in the photograph. They are not visible in the L. O. neg. exposed 58^m, but they show in exposures of 100 minutes and upwards.
270	14.8	
276	13.1	
283	13.9	In the photograph 288 is considerably brighter than 283.
288	13.9	
378	14.8	This star is not shown in Mr. ROBERTS' photograph, as it is immersed in nebulosity. It is about the faintest star shown in Mr. COMMON'S print. It is well shown in the L. O. negatives of 60^m exposure. The L. O. negative of 97^m shows a companion-star *s. p.* 378.

380	13.3	
[413	15.0]	I am not sure that this star can be seen in the photograph.
419	14.2	
422	13.9	
434	11.5	434 seems *somewhat* less bright than BOND's average 11.5 mag. Between 423 and 508 the photograph shows a star 14 + mag. not in BOND. This star just shows in L. O. negative 58^m exposure.
443	13.1	
445	14.8	
478	13.9	There is a star in the photograph closely *s. p.* 478, which is not in BOND'S catalogue. It is not in any of the L. O. negatives up to 97^m exposure.
510	13.1	
511	14.8	
545	13.1	
563	14.4	
566	13.3	
583	11.5	The photograph shows 583 considerably less bright than 11.5. Compare 326, 1051, etc.
587	13.9	
605	13.9	605 and 610 are shown in the photograph as one star. They are shown in the L. O. negatives about $\frac{1}{25}$ of an inch apart, which illustrates one of the advantages of a long focus.
610	14.8	
623	13.9	
644	13.9	
674	14.2	
678	13.9	
680	13.9	
684	14.5	
693	13.9	In the photograph 703 is considerably brighter than 693. It is also slightly brighter in the L. O. negative 58^m exposed, but not so in L. O. negative exposed 97^m. Variable?
703	13.9	
718	13.9	
722	13.3	
749	14.5	
759	15.6	This star is quite bright in the photograph and in some of the L. O. negatives. It is absent or very faint in other L. O. negatives. Variable?
762	13.9	
772	13.9	
[779	15.6]	Not seen in the photograph nor in any of the L. O. negatives.
783	13.9	
786	13.9	In the photograph there is a star 14 + mag. between 786 and 847 not observed by BOND. I do not find it on the L. O. negatives.
787	13.3	
788	13.9	
820	14.2	
[826	14.8]	Does not show in the photograph. It is not seen in L. O. negative exposed 58^m, and just shows in that exposed 97^m.
847	13.1	

865	13.9	
875	14.8	
883	13.3	
888	9.2	is 9.2 and 953 is 9.3 mag., according to BOND, but in the photograph 953 is considerably brighter than 888.
893	13.1	
904	14.2	
912	13.1	
917	13.9	
[929	14.2]	Not seen in the photograph. It does not show in the L. O. negative exposed 58^m, but it is measurable in that exposed 97^m.
936	13.9	
944	14.8	
951	14.8	
953		Between 953 and 1015 are two stars, 14 mag. or less in the photograph, not observed by BOND; these are outside the limits of the L. O. plates.
957	13.9	
[970	14.8]	I am not sure if it is shown in the photograph; just visible in L. O. negative exposed 58^m.
977	13.1	
982	14.2	
999	14.2	The positions in BOND are wrong, but both stars exist and are in the photograph.
1008	13.9	
1011	13.1	These three stars are of the same mag. in BOND, but in the photograph 1029 is much fainter than 1011; 1023 = 1029 in brightness.
1023	13.1	
1029	13.1	
1051	11.5	Between 1015 and 1051 the photograph shows a star 13–14 mag., not in BOND'S catalogue. This region is outside of the L. O. negatives.

The general result of the comparison is, that Mr. ROBERTS' print contains substantially all of BOND'S stars, and it is probable that the negative shows a considerable number of fainter stars. I find that the Lick Observatory negative exposed 58 minutes, shows practically all the stars of Mr. ROBERTS' print. If there is any advantage, it is on the side of the print. The Lick Observatory negative exposed 97 minutes shows more stars than the print. It is probable that the latter negative and that from which Mr. ROBERTS' print was made, are about equal, as far as showing faint stars is concerned. That is, from 80 to 100 minutes exposure with the 33-inch telescope, will give about the same stars as 205^m exposure with the 20-inch reflector. So far, the advantage is with the large aperture, as it should be, and the advantage would be even more apparent, were it not for the great thickness of the Lick Observatory object-glass. When we come to compare the extent of nebulosity depicted, the advantage becomes enormous in favor of the short-focused reflector. By examining the reproductions of Mr. ROBERTS' negatives of *Orion* given in *Knowledge* for May, 1889, page 148, I judge that 15 minutes'

exposure with the reflector is about as effective in showing the nebulosity of *Orion* as 60^m with the refractor! If we take a nebula with a continuous spectrum (like the *Andromeda* nebula), and do not use orthochromatic plates, the advantage in favor of the reflector would be still greater. The pregnant remark quoted by Dr. KONKOLY—"Jedes Fernrohr hat seinen Himmel"—is well illustrated by these comparisons, and they point a very practical moral.

The comparison with Mr. COMMON'S enlargement shows that his print gives about the same amount of nebulosity in 37^m as is given by the Lick Observatory telescope in 97^m, rather more than less. The faintest star shown by Mr. COMMON'S print is probably 378, about 14.8 mag., according to BOND. All of his stars are shown on the Lick Observatory negatives of the shortest exposure (60^m or so), as would be expected. We have so far made no shorter exposures suitable for comparison. When it is considered that this print is an enlargement, the definition appears very fine, and the extent of the nebulosity would probably be even greater, if the picture had been made on the negative plates now in use, which are probably considerably more sensitive than those employed by Mr. COMMON in 1883. An examination of a few negatives lately made at the Lick Observatory gives the following data regarding the performance of the photographic objective ($a = 33$ inches, $f = 570$ inches), on stars.

A negative exposed $81\frac{1}{2}$ minutes on the clusters in *Perseus* shows 202 stars in an area of about $\frac{1}{16}$ of a square degree, in which the Paris picture of 1884 (probably not on the most sensitive plates) exposed 50^m shows 77 stars. A negative of the cluster 20 *Vulpeculæ* exposed 40^m gives everything in Professor SCHULTZ'S map, and something more; that is, it shows stars fainter than 13 mag. of BESSEL, probably as faint as, or fainter, than 13 mag. of ARGELANDER. The Potsdam 13-inch photographic refractor gives a 13 mag. star in about 20^m. The star close following the nebula in *Lyra* is a typical 13.2 mag. star.* In 15^m and 20^m exposure this star is just visible, in 30^m it is measurable, in 60^m the star is very plain. In 60^m the nebula itself just begins to make a complete picture with the 33-inch telescope.

* Professor PICKERING has been kind enough to determine the photographic magnitude of this star. In a letter dated December 2, 1890, he writes: "I have had a photograph of the star in *Lyra*, which you mention, taken with an exposure of 20^m in the 8-inch telescope, and a photograph of the Circumpolar Region on the same plate with the same exposure. This enabled the star in *Lyra* to be compared with the three stars Nos. 489, 506 and 543 in Table XI, p. 138 of Vol. XVIII, of the Observatory Annals. The results for the magnitude of the star in *Lyra* were, respectively, 13.2, 13.0, 13.4. It seems therefore to have about the magnitude 13.2 on the scale of Table XI, just mentioned."